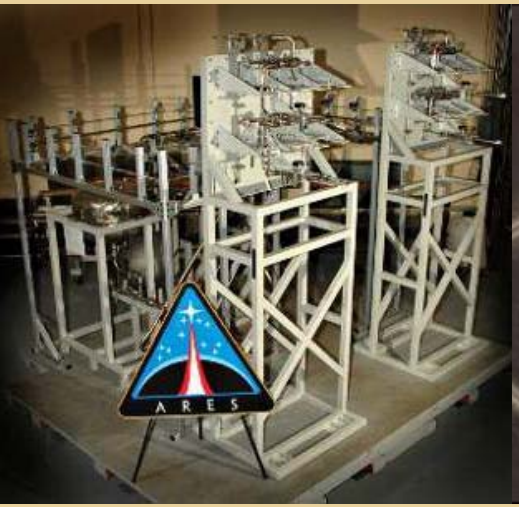



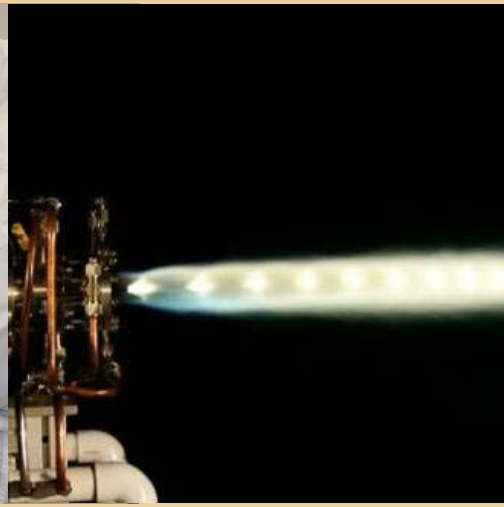

# NASA's Mentor-Protégé Program: Making a Difference... to Orion Propulsion, Inc.

Andy Crocker

Sr. Program Mgr / Director of Bus. Dev.

16 Nov 2009

# Who Is Orion Propulsion, Inc. (OPI)?

- Small, woman-owned business; founded in 2004
- Fundamental belief in hands-on engineering
- ~40 employees with broad aerospace backgrounds
- Specializing in affordable aerospace hardware and engineering services
  - Prototype, development, and production hardware:
    - Propulsion systems (in-space, ACS, RCS, and main)
    - Propulsion elements: rocket engines/motors, combustion devices, ignition/injection systems, fluid/press. systems
    - Ground Support Equipment, Special Test Equipment
  - Propulsion engineering services:
    - Design/analysis: fluids, structures, thermal, CAD
    - Fabrication: prototypes to space flight, parts to systems
    - Testing: hot/cold gas, vacuum to high pressure, component to stage stands
  - Implementation of technology/R&D innovations
- AS9100B certified

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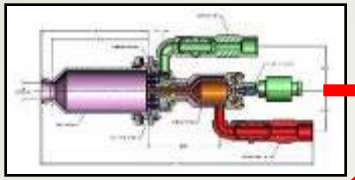
# Who is OPI: Hardware Design and Fabrication

Small Satellite Thrusters

Space Flight Qualified Hydrogen/ Oxygen Propulsion System

Design



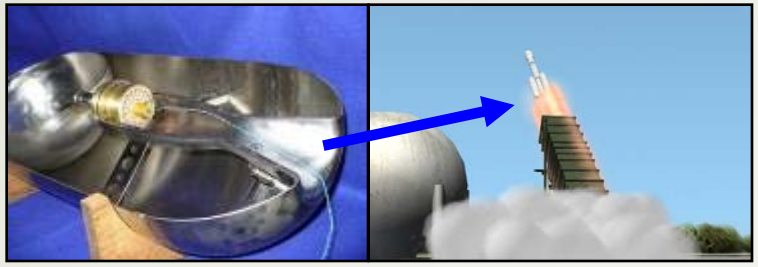
Fabrication

Assembly

Testing

Concept to drawings to fabrication to hot-fire testing in only six weeks

"Rocket Truck" Nitrous/ Asphalt Hybrid Motor



Innovative Small Launcher Propulsion Systems

Attitude and Reaction Control Engines

Flight-like Oxygen/Methane Thruster Assembly

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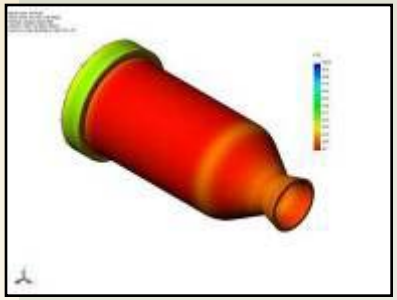
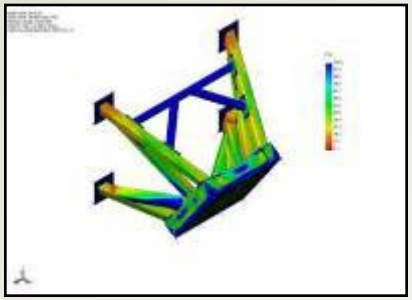
# Who is OPI: Testing, Engineering, and Analysis

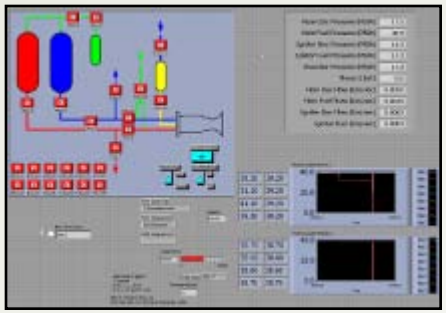
## Test Stands and Test Support

## Engineering Services





## Operations and Support



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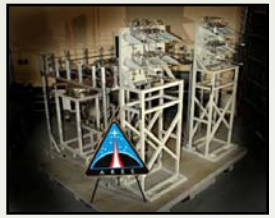
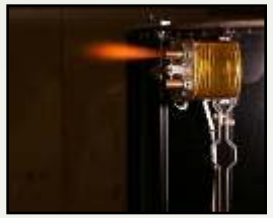
# Who Is OPI: Recent Demonstrated Performance

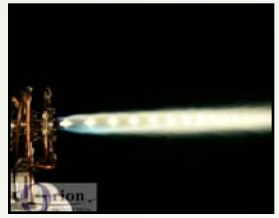
Member of Boeing's Ares I Upper Stage Production team for RCS. Supporting producibility studies. Partnered with Boeing through NASA's Mentor-Protégé program.



Developing and producing the Forward Attitude Control System for the Bigelow Aerospace Sundancer project. Qualification testing completed. Production underway.



For Space and Missile Defense Command: Design, analyze, develop, and test innovative missile propulsion system. Delivering 1st stage tank and motor, test stand, GSE.



Designed, built, tested, and delivered propulsion system for lunar lander testbed to demo and mature technologies for robotic space exploration. RFP to delivery in 14 wks.

Advanced technology projects: developed and tested 100lbf RCS thruster module; gimballing thruster; acoustic igniter; high voltage, light weight, low cost exciter.

# Mentor-Protégé Agreement with Boeing thru NASA

Signed March 31, 2008

- The Agreement was initiated based on mutual interests and common goals
  - Ares I Upper Stage Production
  - Small Business targets
  - Growth of OPI capabilities

NASA

BOEING

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# What Our M-P Agreement Was About

- Technical training
  - Hydrazine training for dealing with toxic propellants
  - Jointly develop RCS production plans and methodologies
  - Lean manufacturing techniques for efficient manufacturing
  - Quality management training for AS9100B certification
- Business development / operations training
  - Project management to streamline project execution
  - Configuration management for handling project changes
  - Human resources to improve company growth planning
  - Business development to improve marketing, financials, business planning, business operations
  - Supply chain management for best practices in procurement, terms & conditions, root cause & corr. action
  - Earned value mgmt for reporting cost, schedule, variances
- Technical Readiness Level advancement (added later)

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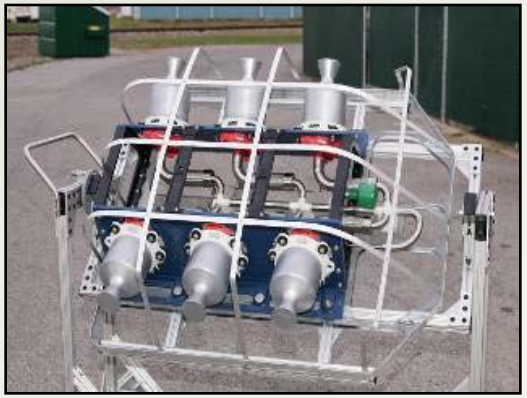
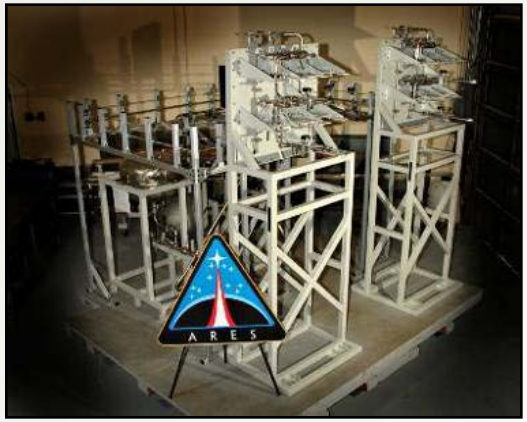
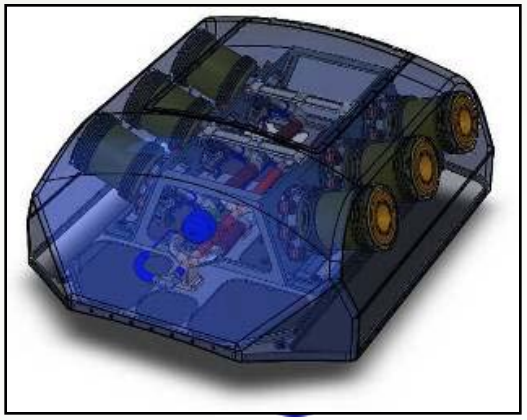
# Activities Related to the M-P Agreement

- Ares I Upper Stage Production
  - OPI provides engineering / technology expertise for thruster and solid rocket requirements
  - OPI built mockups of reaction control and roll control systems for development efforts
  - OPI fabricated development test article for upper stage reaction control system
  - OPI is preparing for ReCS and RoCS thruster module and service panel flight production
- AS9100B certification
  - Boeing provided training and support to develop an AS9100-compliant quality system
  - Boeing completed a 2nd party quality audit Dec 8-11, 2008 to prep for 3rd party audit
  - OPI completed 3rd party AS9100B certification audit in Sept 2009, certified in Nov 2009





# Unwritten Benefits of the M-P Agreement

- Exposure to other parts of the mentor's business
  - Enterprise-wide supplier forums
  - Arranged meetings
- Exposure to the industry
  - Joint conference exhibits with mentor
  - M-P coverage within NASA
- Media coverage
  - Local newspaper, internet
  - Newsletters at NASA, etc.
  - Presentations at tech forums
  - Conference panels (like this one)
- Large company advocate
  - For mentor's own opportunities
  - Intro to other large businesses
  - Intro to the mentor's other suppliers (especially other experienced protégés)
  - For small business awards (SB of the Year)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# OPI Before and After the M-P Agreement

| | 2007 | 2008 | 2009 |
|---|---|---|---|
| Number of Employees (as of) | 12 (Dec 07) | 19 (Mar 08)* | 40 (Nov 09) |
| Number of Facilities | 1 | 1 | 3** |
| Annual Revenue | <$1M | <$5M | >$6M ~30% growth |

* Mentor-Protégé Agreement signed 31 Mar 2008

** Current facilities (all in Greater Huntsville, AL area) include:

- Corporate HQ / Engineering
- Manufacturing / Assembly (with 10k Clean Room)
- Test Area

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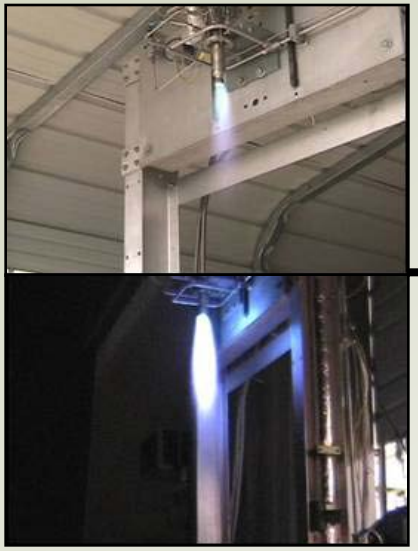
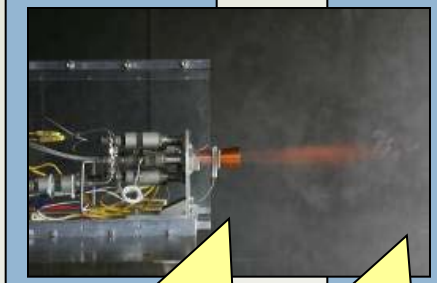
# Additional Benefits of Our M-P Agreement

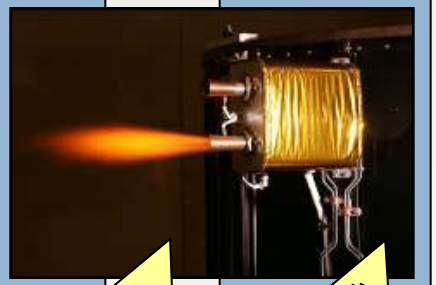


Used Derivative Design from Phase II SBIR (with Same Design Team) for New Hardware Program

**Bigelow Aerospace Sundancer Flight Hardware Program**

| ATP 3/2008 | PDR 5/2008 | CDR 10/2008 | DCR 5/2009 | Deliver Shipsets 10-12/2009 |
|---|---|---|---|---|
| GOX/GH2 Module Design (TRL 4) | | GOX/GH2 Module Dev (TRL 4-6) | GOX/GH2 Module Qual (TRL 7) | GOX/GH2 Module Hardware (TRL 8) |





Quality Mgmt

Lean Mfg

Supplier Mgmt

Program Mgmt

Root Cause

**Boeing-Orion Propulsion Mentor-Protégé Agreement (Mar 2008 – Sep 2009)**

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# M-P Agreement Lessons Learned (1 of 2)

- Link the agreement to a long-term program if possible
  - Ares I Upper Stage worked very well as a focus of training, etc.
- Begin with the end in mind
  - What are the goals? What do both parties need/want as the outcome?
- Set expectations up front
  - Who will and won't be involved? What are reporting requirements?
- Get buy-in—and involvement—from management (on both sides)
  - Management should attend training sessions; lessons trickle down
- Keep people involved who set up the agreement
  - Communicate the purpose and plans to keep from starting over
  - Keep notes from early meetings and conversations for reference
- Have a project manager on both sides (mentor and protégé)
- Establish open and honest communications
  - Mentor must be honest about expectations
  - Protégé must be honest about limits
- Arrange regular tagups
  - Both individually (mentor / protégé separate) and together

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# M-P Agreement Lessons Learned (2 of 2)

- Protégé should be involved in meetings with government sponsor
  - Protégé has unique knowledge about its own technologies, capabilities, and limitations and brings critical perspective to the agreement
  - Joint discussions have the best chance for success
- Try to keep from changing requirements mid-stream
  - Keep the same end/goals in mind throughout
- Don't expect the world
  - Can't take technologies from TRL 4 to TRL 8 in 18 mo. [most of the time]
  - Protégé shouldn't expect lots of new contracts (even with mentor)
  - Keep the goals narrowly focused—other benefits will happen on their own

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# Summary

- Orion Propulsion is very honored to have participated with Boeing as part of the first Agreement under NASA's new Mentor-Protégé Program
- For us, the Mentor-Protégé Agreement provided vital technical and business and operations training which will help us compete for larger, more complex contract awards with NASA and other customers.
- The M-P Agreement has provided us with unique opportunities for growth, both as a member of Boeing's Ares I USP Team and beyond
- The Agreement also gave us exposure within Boeing, in the media, and throughout the industry, as well as a strong large company advocate
- The agreement positively impacted other programs in unplanned ways
- Many benefits will be gained in the coming years as a result
- Each M-P pair must tailor their agreement to fit their needs and situation
- Each M-P pair must plan well and execute well for it to work
- Orion Propulsion is a better supplier and a stronger company for having participated in the M-P program

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